Valuing wilderness recreation: a demand systems approach in the Canadian Shield

P.C. Boxall, J. Englin, and D.O. Watson

Northern Forestry Centre
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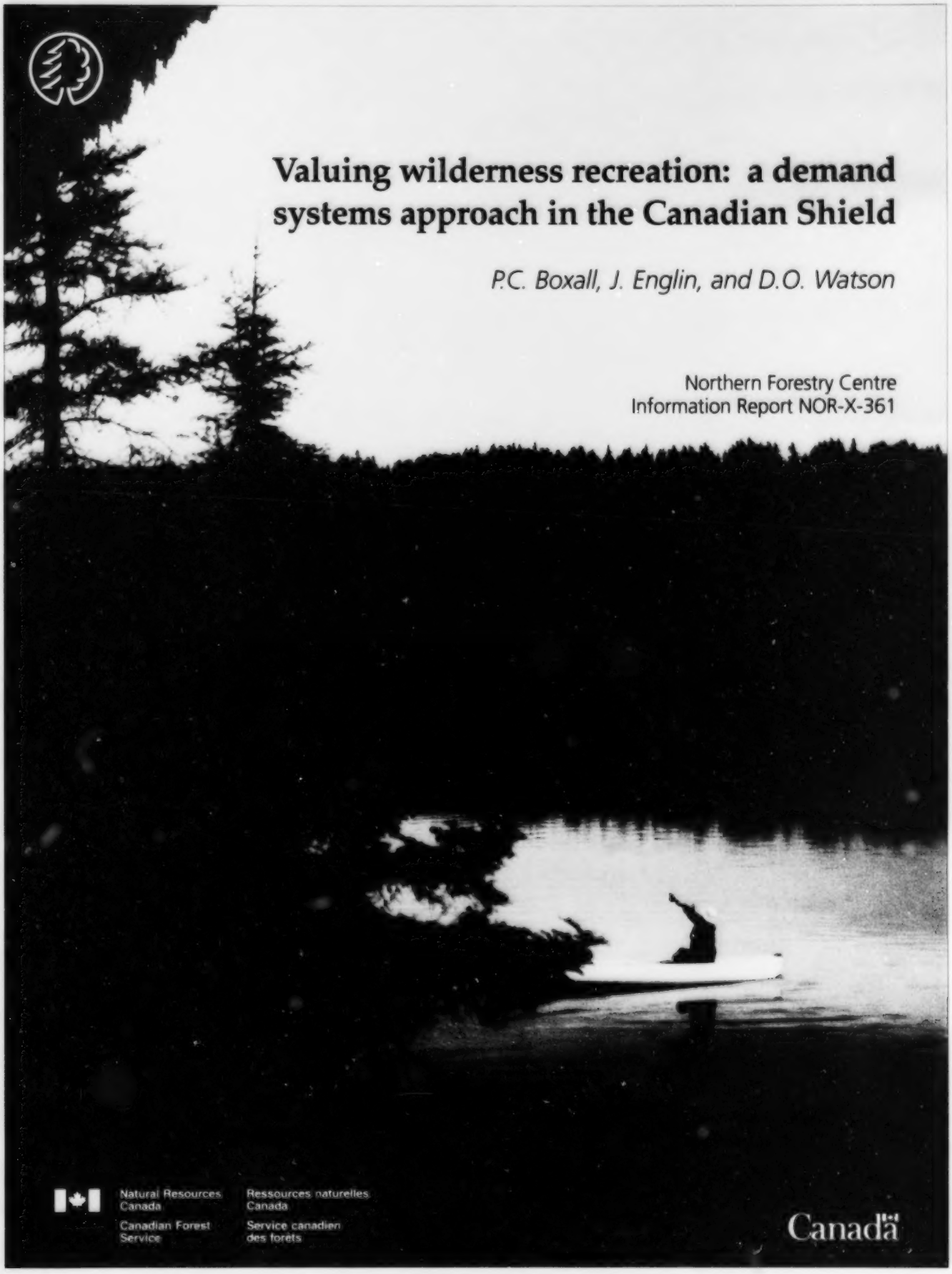

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VALUING WILDERNESS RECREATION: A DEMAND SYSTEMS APPROACH IN THE CANADIAN SHIELD

P.C. Boxall, J. Englin,[1] and D.O. Watson[2]

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ABSTRACT

Backcountry recreation, largely involving canoeing, in four wilderness parks in central Canada was studied in an effort to examine the demand for wilderness recreation areas. The level of visitation to these parks is described and justification for considering these parks in a demand systems framework is provided. Two issues are addressed in a travel cost model: the rate of visitation between parks; and the relative economic value of recreation in these parks. Results suggest that these parks provide considerable nonmarket economic benefit to visitors; however, analysis pertaining to potentially important destinations in the proposed system were not included. The study shows that modeling of visits to systems of wilderness parks is possible in a trip count framework. Considering these particular wilderness parks as a system could play an important role in future wilderness recreation and public land management in this area of the Canadian Shield.

RÉSUMÉ

Les loisirs de plein air, et notamment le canotage, dans quatre parcs de l'arrière-pays du centre du Canada ont fait l'objet d'une étude afin de déterminer la demande d'aires de loisirs en milieu sauvage. Le niveau de fréquentation de ces parcs est indiqué et les raisons de les considérer dans un cadre global de la demande sont fournies. Deux facteurs sont pris en compte dans un modèle de frais de déplacement : le taux de fréquentation des parcs et la valeur économique relative des loisirs qui y sont pratiqués. D'après les résultats obtenus, ces parcs procureraient aux visiteurs d'énormes avantages économiques non commerciaux; toutefois, une analyse des destinations potentiellement importantes dans le système proposé n'a pu être incluse. L'étude montre qu'il est possible de modéliser les excursions dans les parcs de nature sauvage dans un cadre de dénombrement des excursions. La prise en compte de ces parcs en tant que système pourrait jouer un rôle important dans la gestion future des terres publiques et des loisirs de plein air dans cette région du Bouclier canadien.

CONTENTS

FIGURES

TABLES

INTRODUCTION

The southwestern Canadian Shield contains a number of parks and wilderness areas that provide opportunities for unique water-based wilderness trips. These parks include the Boundary Waters Canoe Area (BWCA) in Minnesota; Quetico and Woodland Caribou provincial parks as well as Brightsands, Wabakimi, and Turtle River waterway parks all of which are located in Ontario. They also include the Whiteshell and Nopiming provincial parks as well as the Atikaki Provincial Wilderness Park in Manitoba (Fig. 1). Most of these areas include land withdrawn from forestry or mining operations, and public-land managers are interested in determining the benefits generated by these parks. One benefit provided by wilderness areas is backcountry recreation.

The parks in Figure 1 service a large market that primarily includes people in the central areas of Canada and the northcentral areas of the USA. The proximity of these wilderness areas to each other could be an important factor to this market in the selection of a location for a backcountry trip. For this reason, the wilderness areas and parks in this part of Minnesota, western Ontario, and Manitoba are considered a recreation demand system.[1]

This system is dominated by the BWCA in Minnesota and Quetico Provincial Park in Ontario. Increases in demand for wilderness experiences in these two parks have resulted in reductions in the quality of the backcountry experiences and the imposition of quota entry restrictions. These factors, in conjunction with rising population, declining wilderness areas near population centers, and changes in recreation preferences, are resulting in recreationists considering alternate wilderness recreation areas. The alternate areas in the Canadian Shield are principally the other Canadian parks in this system. While these other parks are farther from major Canadian and U.S. population centers, they currently have no entry restrictions and fewer visitors (Watson et al. 1994, 1996). Given the projections of increases in demand for wilderness recreation by U.S. residents (e.g., Cordell et al. 1990), these Canadian parks could see substantial increases in use and congestion over time. This will create conflict between new visitors and traditional users, increase pressure for further land withdrawals from extractive industries such as forestry, and increase confrontation between industries, commercial recreation outfitters, and recreationists.

This wilderness recreation demand system (Fig. 1) has been a subject of research by the Socioeconomic Research Network of the Canadian Forest Service. To date, studies have involved on-site surveys of park users, inventories of significant biophysical and cultural features of the water routes (Watson et al. 1994, 1996), modeling of both park and water route choice behavior, and estimation of the economic values associated with various features of the water routes (Boxall et al. 1996; Englin et al. 1996).

In examining these parks, a major objective was to explore a related set of questions. First, while visitation to each park primarily involves people from a geographical area in close proximity, is there "cross-visitation" among the set of parks? Second, is the introduction of a relatively new park in the area, Woodland Caribou Park, attracting people from the traditional market areas (e.g., BWCA)? Third, if some individuals consistently visit more than one park in the system, do individual parks provide different experiences or do entry restrictions limit the number of visits to preferred areas?

[1] The Ontario Shield area also contains other parks that are not examined in this study. These parks include Opasquia, Killarney, Kesagami, and Algonquin. While these parks are part of a larger park system, it is suspected that these areas cater to an entirely different market than those parks shown in Figure 1. This market, for example, is more likely to include large Canadian population centres such as Toronto and Ottawa.

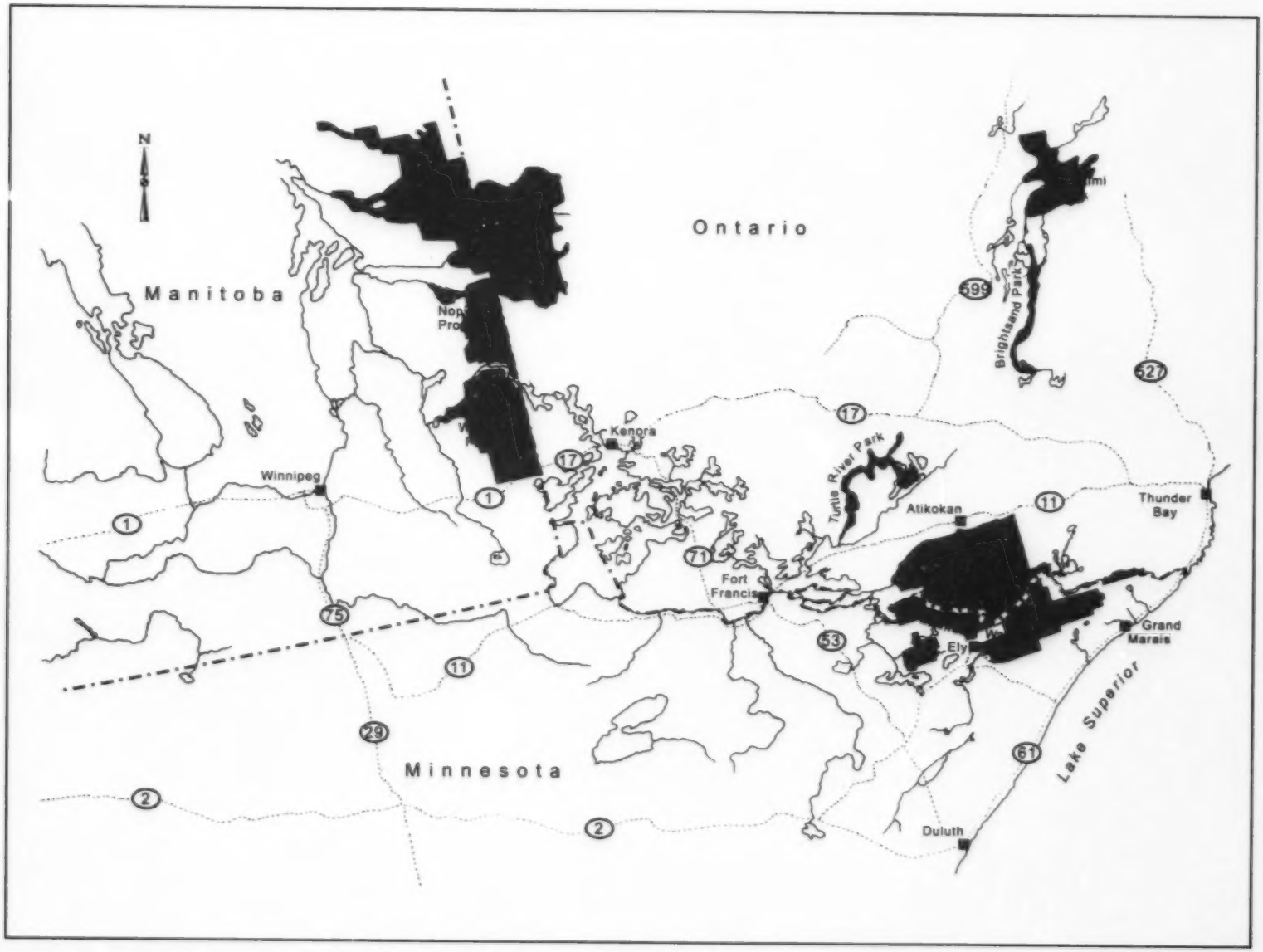

Figure 1. The location of wilderness parks in Manitoba and western Ontario.

A secondary objective was to demonstrate to managers of public lands the value and use of recreation registration systems. While these research efforts are ongoing, the present report provides background information on these parks and develops a model that can examine how changes in management regimes (e.g., fees or park expansion) or levels of environmental quality (e.g., forest fires) at one park will affect levels of visitation and provision of benefits at all of the parks in a system.

The first section of this report describes these parks in terms of numbers and distributions of trips by visitors from Canada, the USA, and elsewhere, and develops the idea of a recreation demand system. The visitation data come from a registration procedure developed by the authors for provincial parks in Manitoba and Ontario (Watson et al. 1994, 1996).

The second section develops a travel cost demand system model using observed visits by individuals living in Canadian and USA population centers. The visitation data were collected using the on-site survey system and were coupled with permit data from Woodland Caribou Provincial Park. To consider the nature of this data properly, a Poisson count system of demands model was used in the econometric analysis of these data. This model is developed using some elements of microeconomic theory and is an improvement over previous attempts in the literature to use count data in recreation demand system models.

THE WILDERNESS RECREATION DEMAND SYSTEM

Description of the Parks

Table 1 summarizes some descriptive features of the six large and formally designated wilderness areas or parks considered in this study. This information was obtained by mailing questionnaires to managers in each park, and was supplemented with field visits. Among these areas, the BWCA in Minnesota and Quetico Provincial Park in Ontario are the oldest. These two areas are famous for their provision of wilderness experiences. Several books (e.g., Beymer 1989; Backes 1991;) have been written about these parks, and potential visitors can obtain abundant information about the ranges of conditions and experiences available in them. The other parks are less well-known nationally or internationally, although Whiteshell Provincial Park is established and well-known to individuals in Manitoba and parts of Ontario. This could be a function of their more-recent formal designation as parks or wilderness areas.

Park managers provided estimates of annual use,which includes both backcountry and formal campground use. As expected, the BWCA dominated the other parks in this category with over 180,000 visitors a year. Quetico had the highest level of visitation among the Canadian parks, followed by Nopiming and Whiteshell. (It is important to note that these counts do include cottagers who might visit the parks repeatedly over a season. Of the six parks, only Nopiming and Whiteshell maintain cottage developments of significant size.)

Park fees varied among the six parks in 1994. Two of the parks (Nopiming and Atikaki) had no fees, while Quetico and Woodland Caribou each had a daily fee charged on a per-person basis. The BWCA had a small reservation fee and restricted backcountry visits through a reservation quota system. The fee charged was per-group and per-reservation. The fee in Whiteshell was $5.00 per car for a three-day visit.

Two of the parks in Manitoba have organized fee campgrounds that are heavily used in the summers. These are not generally used by backcountry visitors, who prefer to camp randomly at various sites or use primitive campground facilities in the backcountry. Other

Table 1. Some characteristics of six wilderness parks in the central Canadian Shield region

Variable	Nopiming	Whiteshell	Atikaki	Woodland Caribou	Boundary Waters Canoe Area	Quetico
Year park was established	1974	1950	1985	1987	1909	1909
Size (km^2)	1 440	2 737	4 068	4 620	4 050	4 050
Estimate of annual use (number of people)	5 000	3 000+	250	1 500	180 000	24 000
Backcountry use or park entry fee (1994)	None	$5.00/ vehicle	None	$4.25/ person/day	$7.00/ group	$4.25/ person/day
Presence of formal campgrounds accessed by road	Yes	Yes	No	No	No	No
Interior road access	Yes	Yes	No	No	No	No
Mining or forest harvesting	Yes	Yes	No	No	No	No
Cottage developments	Yes	Yes	No	No	No	No

important differences include the existence of industrial forest and mine operations on a limited scale in Nopiming and Whiteshell. These operations mostly involve forestry, and in Nopiming the existence of logging is an important provincial environmental issue.[2]

The intention of this study was to capture information from visitors to all six of these parks, and also the waterway parks in Ontario. In order to do this, methods were developed to gather information from recreationists at some parks and to harmonize this information with the permit systems in place in other parks. The next section describes the efforts and the success with which these processes were implemented.

Data Collection

The first step in understanding the demand for trips to these parks was to gather data on visitation. This was difficult because the parks are located over several jurisdictions with different regulations, and even within the same jurisdiction, the management systems varied. Thus, the first step in this process was to harmonize an entry/registration system for visitors among as many of the parks as possible.

This proved impossible for the BWCA, because U.S. federal privacy laws prohibit the collection of registration data and storage or sharing of information on individual visitors. The authors, however, were able to obtain information summaries from annual bulletins prepared by U.S. Forest Service staff in Duluth and Grand Marais. This provided an approximation of the levels of visitation to BWCA and a picture of where most of the visitors were coming from. Nonetheless, for more sophisticated modeling purposes the BWCA had to be excluded from the system analysis.

The information from the three Manitoba parks was generated from a registration system

[2] For example between 1991 and the end of 1993 there were 96 articles or editorial comments in the Winnipeg Free Press on this issue (personal communication January 1998, Winnipeg Free Press).

that was designed specifically for this and other studies. This registration system involved the establishment of self-registration survey stations at backcountry entry points and/or park management offices. Air carriers and outfitters were also provided with registration materials so that clients could be included in the visitation data base. Each on-site registration station consisted of a wooden box containing surveys, pencils, and maps for backcountry visitors to use. These stations are described in detail by Watson et al. (1994). The boxes were checked periodically to collect completed surveys and for restocking.

The survey asked for: the name and address of the leader of each recreation group, the number of people in the group, the type of social group, type and number of watercraft, the starting and completion dates of the trip, the number of times the group had visited areas within the park in the last 10 years, group awareness of other routes in the park, and group's expected route and camping locations, to be traced on a map located on the back of the survey. Figure 2 is an example of the survey that was used for Nopiming Provincial Park. The Whiteshell and Atikaki surveys were similar.

Unsuccessful attempts were made to implement the same registration system for the Ontario parks. As with BWCA, Ontario privacy protection laws do not allow personal information about users to be shared or circulated. To get information about users, therefore, Canadian Forest Service registration survey forms were used. Staff at Quetico Provincial Park were reluctant to integrate this system with the park registration system because they felt that visitors had been surveyed numerous times in the recent past (Rollins et al. 1997);however, Quetico staff were willing to share their registration data as long as the information provided could not be linked to an individual registrant. As discussed below, this was of limited use in the current analysis, but might be useful for examining visits from locations on an aggregate basis in the future.

The survey boxes designed for the Manitoba parks were provided to Ontario parks staff at the three waterway parks and Woodland Caribou Provincial Park. Due to a number of circumstances, however, only Woodland Caribou Park used the stations, installing them at the two sole entry points to the park. Surveys were designed specifically for these stations and research staff provided sufficient copies along with the registration station. Figure 3 is an example of the registration survey for Woodland Caribou Park. Note that the form is similar in many respects to the Manitoba form (Fig. 2) except that data on visits to other parks were gathered from registrants rather than specific backcountry route information.

Staff at Woodland Caribou Park were particularly helpful with this project by permitting access to individual registration records that had been stored since the park was established. Surveys were mailed to registrants who were missing from the on-site self-registration process. Names and addresses of those who did not respond could still be used in subsequent analyses.

In summary, efforts at establishing a data base from visits to all of the wilderness parks in Figure 1 were not completely successful. Due to a combination of circumstances including lack of time caused by severe fires and reluctance by park managers to participate in the study, a data base was established that included only a part of what is probably the complete wilderness park demand system. This portion of the system includes Whiteshell, Nopiming, and Atikaki parks in Manitoba, and Woodland Caribou Park in Ontario. Despite the incomplete nature of the data, a partial demand system model was estimated to provide some insights into the importance and significance of these areas to both Canadian and international recreation markets.

Levels of Visitation to the Wilderness Parks

Table 2 summarizes permits and surveys completed for the six major parks for the period 1991–1994. Complete data were not available for all of the parks. As expected, the BWCA dominated the system, with over 25 000 groups visiting backcountry areas annually from 1991 to 1994. Visits to Quetico were much fewer, estimated at about 5097 groups in each of 1993 and 1994. The Manitoba parks experienced fewer visits than Quetico, with Nopiming supporting the largest number of backcountry trips among the three Manitoba parks. Woodland Caribou

No: ☐ Route: ☐

NOPIMING PROVINCIAL PARK
BACKCOUNTRY REGISTRATION

Thank you for taking the time to complete this form. The information will help the Department of Natural Resources and the Canadian Forest Service understand how you use this area and enable staff to better manage backcountry water recreation routes.
Note: This information is not for search and rescue purposes. Please ensure that you tell a family member or friend which route you are travelling and when you are expected back home.

1. Group Leader's Name ..... (First / Middle Initial / Last)
2. Group Leader's Mailing Address ..... (Number / Street / City/Town)
..... (Province/State and Country / Postal/Zip Code)

Names of other group members: .....

3. Number of People in the group? ☐
4. How would you describe your group?
☐ Family ☐ Friends ☐ School/University ☐ Youth
5. Type of watercraft?
☐ Canoe ☐ Canoe with motor ☐ Boat and motor ☐ Other
6. Number of watercraft in the group? ☐

7. Trip start date? ..... (day month year) 8. Expected date of trip completion ..... (day month year)
9. How many times have you visited **this** route in the last ten years?
☐ None ☐ Once ☐ Twice ☐ Three ☐ Four ☐ Five or more

10. Which routes have you used in the park in the last ten years?
☐ Manigotagan R. area ☐ Black L./Rabbit R. ☐ Booster L./Flanders L. area
☐ Beresford L. area ☐ Shoe L./Cat L. area ☐ Other (specify) .....
☐ Garner L. area ☐ Euclid/Springer L. area .....
☐ Seagrim L. area ☐ Bird R. area .....

11. What was the primary purpose for your visit to the park?
☐ Canoe trip ☐ Motor boat trip ☐ Other (specify) .....
☐ Fishing ☐ Camping .....
☐ Hunting .....

12. It is very important to learn what specific water recreation routes are used in Nopiming park. Please refer to the map on the back of this survey and trace your intended route from the staging area. Also, indicate with an ⊗ where you intend to camp.

Figure 2. The Nopiming Provincial Park Backcountry Registration survey form.

Ontario
Ministry of Natural Resources

WOODLAND CARIBOU PROVINCIAL PARK
BACKCOUNTRY SURVEY

Thank you for taking the time to complete this form. The information will help the Ministry of Natural Resources and the Canadian Forest Service understand how you use this area and enable staff to better manage backcountry water recreation routes. Note: This information is not for search and rescue purposes. Please ensure that you tell a family member or friend which route you are travelling and when you are expected back home.
Opinions expressed become part of the public record unless specifically requested otherwise.

1. Group Leader's Name ..... (First / Middle Initial / Last)
2. Group Leader's Mailing Address ..... (Number / Street / City/Town)
..... (Province/State and Country / Postal/Zip Code)
3. Number of People in the group? ☐
4. How would you describe your group?
☐ Family ☐ Friends ☐ School/University ☐ Youth
5. Type of watercraft?
☐ Canoe ☐ Canoe with motor ☐ Boat and motor ☐ Other
6. Number of watercraft in the group? ☐

7. Trip start date? ..... (day month year) 8. Expected date of trip completion ..... (day month year)
9. How many times have you visited **this** route in the last ten years?
☐ None ☐ Once ☐ Twice ☐ Three ☐ Four ☐ Five or more

10. Which routes have you used in the park in the last ten years?
☐ Sabourin River ☐ Bloodvein River ☐ Other (specify) .....
☐ Gammon River ☐ Simeon Creek .....
☐ Optic Lake/Hansen Lake ☐ Haggart River .....

11. Which of the following parks have you visited the last ten years?
☐ Quetico ☐ Bright Sands ☐ Other (specify) .....
☐ Turtle River ☐ Nopiming .....
☐ Wabakimi ☐ Whiteshell .....
☐ Boundary Waters ☐ Atikaki .....

12. What was the primary purpose for your visit to the park?
☐ Canoe trip ☐ Motor boat trip ☐ Other (specify) .....
☐ Fishing ☐ Camping .....

13. What means of transportation did you use to access Woodland Caribou park?
☐ Land (road) ☐ Water ☐ Water (from Manitoba) ☐ Air
☐ Other or Combination of above (specify) .....

14. It is very important to learn what specific water recreation routes are used in Woodland Caribou park. Please refer to the map on the back of this survey and trace your intended route from the staging area. Also, indicate with an ⊗ where you intend to camp.

Figure 3. The Woodland Caribou Provincial Park Backcountry Registration survey form.

Table 2. Number of on-site surveys or permits for the period 1991–1994 collected from six wilderness parks

Park	Number of permits or on-site survey returns			
	1991	1992	1993	1994
Boundary Waters Canoe Area[a]	26 368	27 023	28 593	27 117
Quetico[b]	n/a[c]	n/a	5 097	5 097
Nopiming[d]	258	249	389	272
Whiteshell[d]	n/a	n/a	81	253
Atikaki[d]	n/a	n/a	57	37
Woodland Caribou[e]	19	63	78	123

[a] BWCA data come from overnight visits and were gathered from an informal information bulletin provided by the U.S. Forest Service. This information represents numbers of groups. Mean group size is not available.

[b] Quetico data are approximate because they come from a data base of permits from the 1993 and 1994 seasons. The numbers represent groups, not individuals and the mean group size is 4.05 individuals/group.

[c] n/a = not available.

[d] Nopiming information is based on data collected by Manitoba Natural Resources for 1991 and 1992; Whiteshell and Atikaki information for 1991 and 1992 was not collected by Manitoba Natural Resources; however, some information at Whiteshell for 1993 was obtained but is incomplete as a formal registration system was not implemented by the authors. Note that these data represent the numbers of groups, not individual visitors. Mean group size based on the survey returns for Nopiming is 4.03 individuals/group, 4.41 for Whiteshell, and 5.93 for Atikaki.

[e] Woodland Caribou data were obtained from an inventory of entry permits collected by Ontario Ministry of Natural Resources, Parks Department. This information represents the numbers of groups; the mean group size is 3.81 individuals.

Park numbers were similar to Atikaki Park, except in 1994 when it apparently supported a larger number of trips.

Visits to the BWCA increased each year during 1991–1993, but declined in 1994. While the data required to examine visitation trends for Quetico are inadequate, the park's visitation trend was likely similar to the BWCA because of the parks' proximity to each other and the fact that of all the parks, Quetico and BWCA maintain entry quotas in addition to fees (Table 1). Visits to Nopiming were relatively constant over the period. Data for Whiteshell and Atikaki were not of sufficient quality to examine annual differences in visits. Finally, visits to Woodland Caribou Park increased over time. The park was officially established in 1991, and since the first year, visits increased significantly.

Origins of Visitors to the Wilderness Parks

The distribution of the origins of visitors to the six parks is shown in Figures 4 and 5. The origins are based on the group leaders' addresses and, it is assumed throughout that other members of the groups came from the same origins as the leaders. The majority of visitors to Quetico, Woodland Caribou, and the BWCA were from the USA (Fig. 4). Approximately 66% of the BWCA visits, 21% of the Quetico visits, and 23% of the Woodland Caribou visits were by residents of Minnesota; about 25%, 67%, and 41%, respectively of the visits to the three parks were by individuals from other states. About 11% of the Quetico visits were by Canadians, principally residents of Ontario. In Woodland Caribou, 26% of the visits were by people from Ontario and 8.7% from Winnipeg, Manitoba.

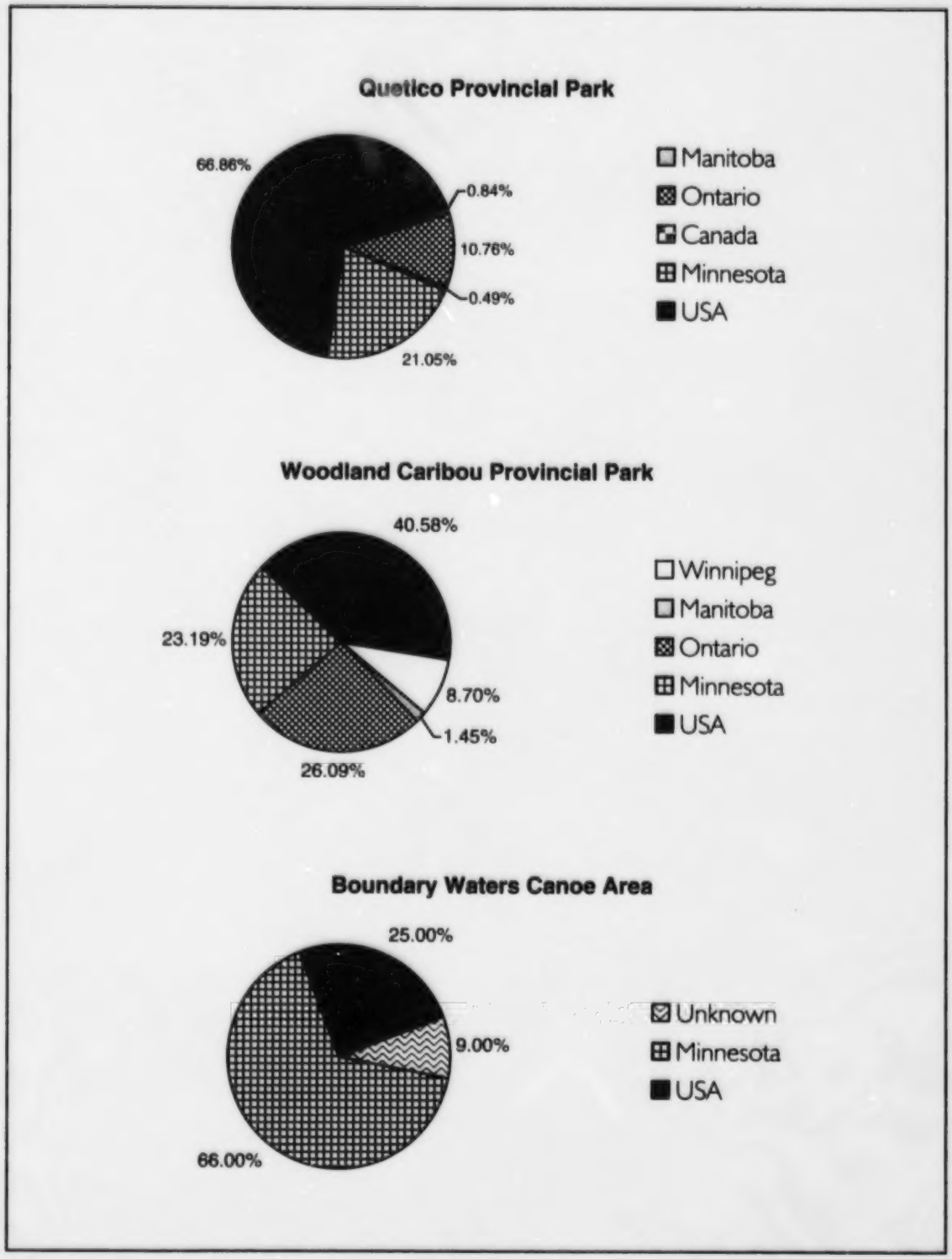

Figure 4. The percentage distribution of visitor origins for Quetico and Woodland Caribou provincial parks in Ontario and the Boundary Water Canoe Area in Minnesota for 1994.

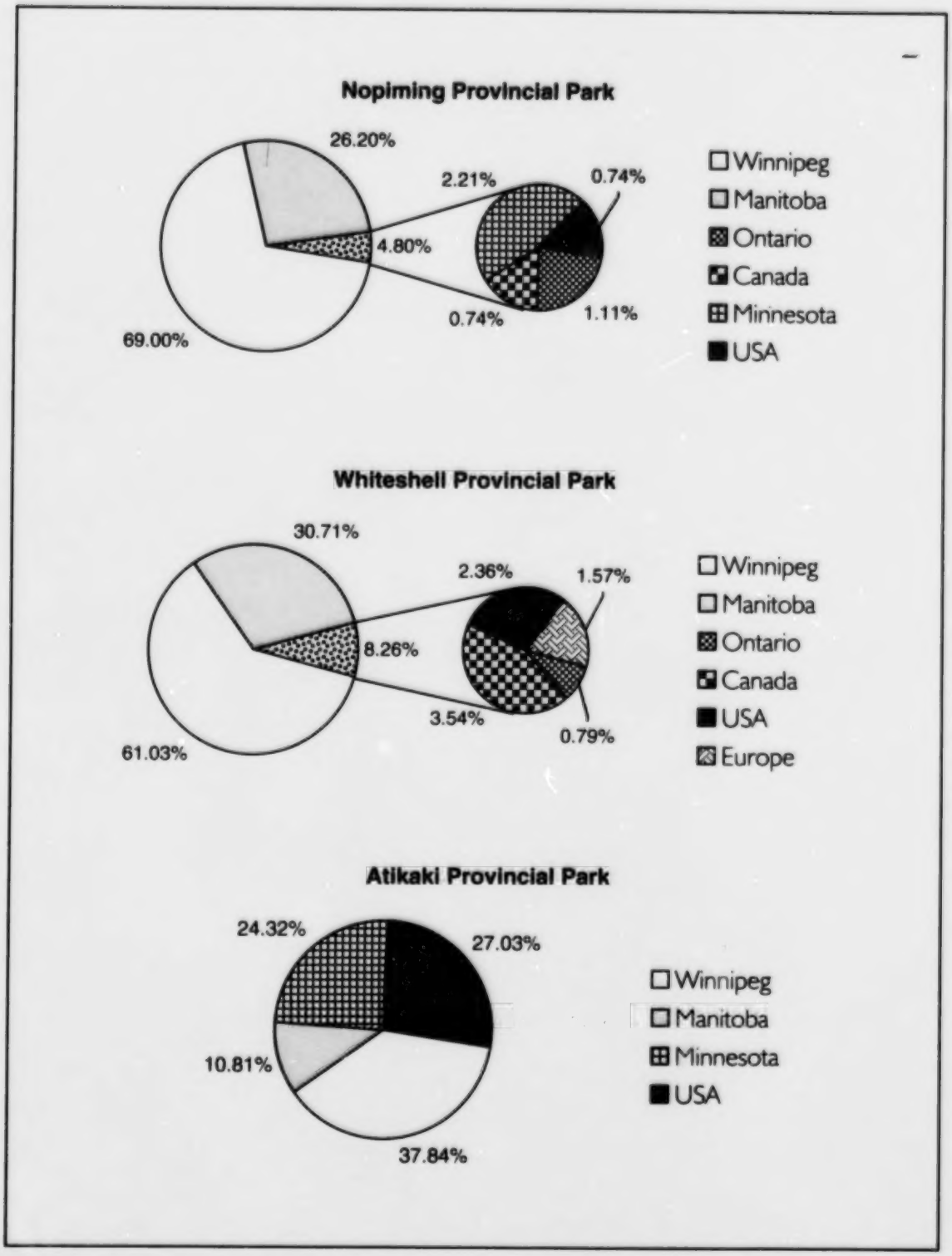

Figure 5. **The percentage distribution of visitor origins for Nopiming, Whiteshell, and Atikaki provincial parks in Manitoba for 1994.**

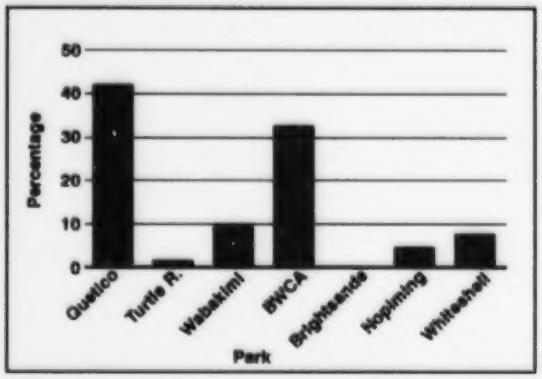

Figure 6. The distribution of visits to other parks by Woodland Caribou survey registrants.

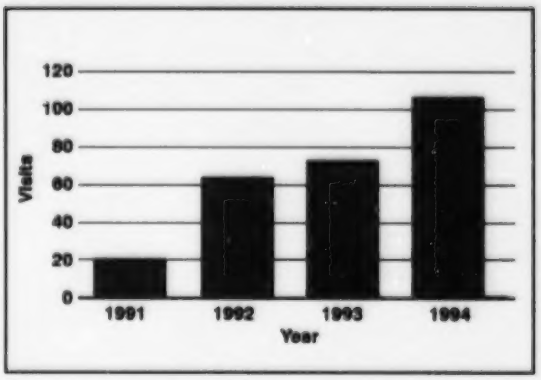

Figure 7. The number of visits to Woodland Caribou Park from 1991 to 1994 based on permit data provided by park staff.

The distribution of visitor origins is shown for the three Manitoba parks in Figure 5. Over 90% of the visits to Nopiming and Whiteshell, and 48% of the visits to Atikaki, were by residents of Manitoba. Of these, approximately 69%, 61%, and 38%, respectively were by individuals from Winnipeg. Non-Canadians comprised just over 3% of the visits to Nopiming, with about 2% coming from Minnesota. Similarly, U.S. residents comprised about 3% of visits to Whiteshell, while about 3.5% of the visits were from Canadians not residing in Manitoba. About 24% of the visits to Atikaki were by Minnesota residents and a further 27% were by individuals from other U.S. states.

This information suggests that the various parks appear to be serving different market areas: the BWCA and Quetico are principally serving Minnesota; and Nopiming and Whiteshell are predominantly serving Winnipeg and other parts of Manitoba. The high proportion of visits by Minnesotans and other U.S. residents to Woodland Caribou and Atikaki, however, suggests that the entry restrictions and high use of the parks closer to the Canada–U.S. border (e.g., BWCA and Quetico) could be forcing some individuals farther north in search of an authentic wilderness recreation experience. Anecdotal observations and interviews with recreationists made during field visits support this notion. For example, a Minnesota family interviewed in Nopiming claimed that the BWCA had been ruined through overuse and that routes were so congested with people that "portages were like highways."

This trend of visitors moving north was explored further by examining the information retrieved from the Woodland Caribou surveys. Figure 6 shows the distribution of visits to other parks reported by these Woodland Caribou visitors. Over 40% of them had visited Quetico and over 30% had visited the BWCA. Visits to the other parks identified in the survey were not reported as frequently. Furthermore, the growth in the total trips to this park since 1991 (Figure 7), coupled with the frequency of visits to the park per individual from the survey, suggests that Woodland Caribou is likely to experience a considerable increase in popularity in the Minnesota/USA market in the future.

Cross-visitation among Nopiming, Whiteshell, Atikaki, and Woodland Caribou Parks

The information from the self-registration surveys and permits from Canadian and U.S. residents for 1993 and 1994 was entered into a computer data base. For the reasons outlined earlier, comparable information was only available from groups who visited the three Manitoba parks and Woodland Caribou Park. Using the group leaders' names and addresses, each record in the data base was cross-linked to determine multiple visits in the 2 years to one or

Table 3. The number of trips made by 939 identifiable groups to backcountry areas in four parks during 1993 and 1994

	Number of trips				
Number of trips	Nopiming	Whiteshell	Atikaki	Woodland Caribou	System total
0	402 (42.8)[a]	705 (75.1)	871 (92.8)	818 (87.1)	
1	470 (50.1)	221 (23.5)	62 (6.6)	88 (9.4)	812 (86.5)
2	52 (5.5)	10 (1.1)	5 (0.5)	26 (2.8)	95 (10.1)
3	12 (1.4)	1 (0.1)	0	5 (0.5)	21 (2.2)
4 or more	3 (0.3)	2 (0.2)	1 (0.1)	2 (0.2)	11 (1.1)
Mean trips/group	0.66	0.27	0.09	0.18	1.00

[a] Numbers in parentheses refer to the percentage of trips by the 939 groups.

more of the four parks. The result is a new record that outlines 1122 trips by at least 939 individual recreation groups to the four-park system during the 2-year period. A summary of these trips is shown in Table 3. For the 939 individual groups, 812 took one trip, 95 took two trips, 21 took three trips, and 11 took four or more trips to the parks during the 2-year period. Most of the visits were to Nopiming park, while the fewest were to Atikaki. Multiple trips by individuals were found to include more than one trip to the same park as well as trips to multiple parks. Note that because a group was only recognized by reporting at least one trip, none of the individual groups had zero trips to the system (Table 3). However, some of the groups could have had zero trips to an individual park.

MODELING OF WILDERNESS RECREATION AS A SYSTEM OF DEMANDS

Travel Cost Models

The travel cost model (TCM) is commonly used to estimate the demand for recreation and to measure associated economic values using some welfare measure. The model uses trips to recreation sites as quantities and the costs of traveling between an individual's residence and the site as a proxy for the price of a trip. The model therefore relies on behavior, in that the site choices of individuals must be observed by the investigator, and that market purchases associated with this behavior (travel costs) are weakly complementary to the choice of a recreation site (Fletcher et al. 1990). There is a considerable theoretical foundation for the TCM because the recreation preferences of individuals are thought to be revealed through their observed choice of recreation sites (Smith 1989). This foundation is recognized in the literature in that the various types of TCMs are called revealed preference methods by nonmarket valuation specialists (e.g., Mendelsohn and Brown 1983).

The development of the travel cost method has been attributed to Harold Hotelling, who described the fundamental ideas behind the model in a letter to the U.S. National Parks Service in 1947. Since the first applications of the model by Trice and Wood (1958) and Clawson (1959), the travel cost literature has grown large and a number of variations of the TCM have been developed for various purposes. This literature and the theoretical issues surrounding the use of the travel cost method are summarized by Smith (1989) and Fletcher et al. (1990). The model used in this report deals with an extension to what is called the traditional or Hotelling-Clawson-Knetsch TCM. The traditional TCM, described by Rosenthal et al. (1984) and Dwyer et al. (1977), involves the derivation of a demand curve by using the number of trips taken and associated travel costs as price–quantity pairs. A typical single site model can be represented by:

$$\text{Number of trips} = f\ (\text{TCOST, INC, SUBS}) \qquad (1)$$

where TCOST is the travel costs faced by an individual recreationist to the recreation site; INC is the income level and/or other socioeconomic variables for the individual; and SUBS is a measure of available substitute recreation sites. Each individual thus faces a set of prices (travel costs) and chooses a bundle of goods (visits to sites). This demand function is typically estimated using ordinary least squares procedures (OLS). The resulting model allows consumer surplus associated with the recreational activity at that site to be calculated. This welfare measure is usually the objective of the analysis, thus the travel cost demand equation must be linked to some form of utility maximization.

Travel Cost Models in a Demand System and Count Data Framework

The substitute site measure in equation (1) is perhaps the simplest way of incorporating the idea that individuals have alternative site opportunities for their recreational activities. Stronger theoretical and econometric approaches, however, have been explored by consumer demand researchers (e.g., Pollak and Wales 1992). Such work has advanced the study of demand behavior through an approach called demand systems analysis. These ideas were first applied in TCMs by Burt and Brewer (1971) in what is called is the multiple site TCM. Burt and Brewer formalized the idea that several recreation sites could be substitutes for each other in a system of recreation demand equations. This intuition was formalized in two ways. First, the prices of the substitute sites were introduced explicitly into each recreation site's demand equation. Second, the demand equations were treated as a system econometrically through the imposition of appropriate cross-equation restrictions. These restrictions were imposed to assure integrability, a requirement of utility maximization, which is a major component of microeconomic theory (e.g., Varian 1992).

A recent innovation in travel cost demand modeling has been the use of discrete count distributions (Creel and Loomis 1990; Hellerstein 1991). Count distributions are attractive because they only consider zeros and small integers for the dependent variable (number of trips), which are common characteristics of recreation trip demand. The OLS-related procedures used by Burt and Brewer (1971) are not suited to considering conditions of nonnegative integer values, or count data, for dependent variables. There is therefore a need to consider "systems of counts" in travel cost analyses. Count data approaches, while attractive, however, require the use of semilogarithmic functional forms for modeling demand. Semilogarithmic functional forms require the application of different integrability restrictions than the linear demand system used by Burt and Brewer (1971). These restrictions have been developed by LaFrance (1990).

To understand these procedures, consider a demand function for recreation at a singie park specified with a semilogarithmic functional form. This function is:

$$\ln(y_i) = \alpha_1 + \sum_{j=1}^{n} \beta_j p_{ij} + \gamma m_i \qquad (2)$$

where y_i is quantity of trips by recreationist i to park j=1, α_1 is the intercept associated with that park, p_j are travel costs faced by i for trips to that park and all others that could be visited (j=1,...,n), m_i is the recreationist's income, and β_j and γ are parameters to be estimated. If the economic benefits associated with recreating at the single park are of interest, equation (2) is sufficient for welfare estimation. This involves integrating equation (2) between two prices, P_0 and P_1, the result of which provides an estimate of the economic value or consumer surplus associated with visits to that park. If, however, the concern is valuing recreation at a system of parks, then a system of demand functions must be examined and integrability among the system becomes an important consideration.

Now consider the following system of demand functions for recreation trips to four parks:

$$\ln(y_{i,1}) = \alpha_1 + \sum_{j=1}^{4} \beta_j p_{ij} + \gamma_1 m_i$$

$$\ln(y_{i,2}) = \alpha_2 + \sum_{j=1}^{4} \beta_j p_{ij} + \gamma_2 m_i \qquad (3)$$

$$\ln(y_{i,3}) = \alpha_3 + \sum_{j=1}^{4} \beta_j p_{ij} + \gamma_3 m_i$$

$$\ln(y_{i,4}) = \alpha_4 + \sum_{j=1}^{4} \beta_j p_{ij} + \gamma_4 m_i$$

LaFrance (1990) demonstrates the conditions that such a system of semilogarithmic demand functions must fulfill in order to form an integrable demand system. These conditions take the form of restrictions on the intercept, cross-price, and income effects in the system of equations. The intercept restrictions are:

$$\alpha_j = \alpha_1 \left(\frac{\beta_{jj}}{\beta_{11}}\right) \qquad (4)$$

where α_j is the intercept for the jth park, β_{jj} is the own-price coefficient for the jth park, and α_1 and β_{11} are the intercept and own-price coefficient for park 1. The effect of this restriction is that only one of the intercepts, α_1, is identified in the system econometric model. The remaining intercepts are calculated as functions of α_j and the two own-price parameters as shown in (4).

The second restriction is that there is only one income effect (γ) for the system. In essence, the sub-utility function that describes the closely related parks has a single income effect (γ) rather than one for each park.

Finally, the compensated or Hicksian demand cross-price effects are all restricted to be zero. Note, however, that the uncompensated or Marshallian cross-price effects are non-zero. These are calculated using the Slutsky equation described in most textbooks of economic theory (e.g., Varian 1992). This equation is:

$$\frac{\partial y_j(p,m)}{\partial p_k} = \frac{\partial y_j^h(p,m)}{\partial p_k} - \frac{\partial y_j(p,m)}{\partial m} y_k$$

where $y_j(p,m)$ represents the uncompensated demand function for park j, and $y^h_j(p,m)$ represents the compensated demand function for park j. Applying the restriction that $\partial y_j(p,m)/\partial p_k = 0$ and rearranging, this equation becomes:

$$\frac{\partial y_j^h(p,m)}{\partial p_k} = \frac{\partial y_j(p,m)}{\partial m} y_k$$

Because $y_j(p,m)$ represents the demand function in equation 1 for the ith individual visiting park j = 1, differentiating equation (2) with respect to m ($\partial y_i/\partial m$) is γy_{ij}. Thus, the compensated substitution effect for this ith individual between parks k and j (s_{kj}) is calculated by:

$$s_{kj} = \gamma y_k y_j \qquad (5)$$

where y's are quantities of trips to parks k and j by individual i.

As a result of these restrictions, only a single intercept (α_i), a single income effect (γ), and own-price parameters (β_{ij}) need to be estimated. To recover the full compensated demand system implied by these parameters, one must decide who or what measures of the sample represent appropriate estimates of individual i. Possible candidates include the data means of the sample (e.g., mean income, prices and trips) or the characteristics of the median individual. Alternatively, one could calculate the implied compensated demand system for each individual in the data and then take the mean of the results.

The cross-price effects in this model will be symmetric, but they will not be identical across individuals who might choose different quantity pairs. The compensated semilogarithmic system parameters calculated at any given point will therefore look like a cross-price constrained incomplete linear demand system. In the linear system, however, the parameters are constant regardless of the consumption point, while in the semilogarithmic system the relationships among the parameters are constant. These differences have not been recognized in previous research on semilogarithmic recreation demand systems (e.g., Ozuna and Gomez 1994). Integrability among the parks in the system is possible, therefore, consumer surplus estimates for recreation at each park can be derived from the system demand parameters. The implication of integrability is that the model is consistent with economic theory and that the consumer surplus estimates derived from the demand parameters are defensible on theoretical grounds.

This model is applied to a subset of the system of parks described in the first section of this report. The empirical application of this model involves a Poisson demand system applied to trips to Whiteshell, Nopiming, Atikaki, and Woodland Caribou parks. A Poisson specification is characterized by observing only nonnegative integer values for the number of trips (y) to any park by the i^{th} individual. Thus, $y_i \geq 0$ and $y_i = \{0,1,2,....,N\}$. The Poisson density function describing this trip behavior for one park is:

$$\text{prob}\,(y = y_i) = \frac{\exp^{-\lambda_i} \lambda_i^{y_i}}{y_i!} \qquad (6)$$

This function is consistent with the semilogarithmic functional form because $\lambda_i = \exp^{x\beta}$, where x represents independent variables and β represents parameters. For the four parks, this function for the ith individual becomes:

$$\prod_{j=1}^{4} \frac{\exp^{-\lambda_{ij}} \lambda_{ij}^{y_{ij}}}{y_{ij}!} \qquad (7)$$

By taking natural logarithms of this function, the log density function becomes:

$$\sum_{j=1}^{4} -\lambda_{ij} + y_{ij} \ln(\lambda_{ij}) - \ln y_{ij}! \qquad (8)$$

By substituting $e^{x\beta}$ for λ, where x represents a vector of travel costs, income,and other variables and β represents a vector of parameters, equation (8) can be used as a log likelihood function where β is estimated by maximum likelihood (ML) methods. In order to ensure that the estimated parameters are consistent with the demand model described above, the cross-equation restrictions must be applied to each set of parameters in the ML process.

Specification of Variables and Model Estimation

The data used to estimate this model come from the surveys and permits that form the basis for Table 3. This data included the name and address of each group leader, group size, trip length in days, type of transport used for entry to backcountry areas, and other information on the group leader of backcountry visits to the four parks over 2 years. The data base used consists of 1122 trips made by 939 groups. The group leader's name identified the group, thus each group is treated as an individual in the econometric analysis,with the assumption that all individuals in a group come from the same origin as the group leader and have the group leader's socioeconomic characteristics. The use of group leaders' residences to represent those of all others in their group is common in recreation demand literature (e.g., Hellerstein 1991); thus, although the TCM estimated is based on group trips, a trip record will be considered as one from an individual weighted by the number of people accompanying the leader of the group. As shown below, however, the group size formally enters the analysis in the calculation of travel costs and in the estimation of economic benefits.

A summary of the frequency of trips to the various parks is provided in Table 3. The Poisson count framework should be useful in analyzing these trips because few individuals took more than one or two trips to a park in a given year, and many visited only a single park (Table 3). These recreation trips are clearly not suited to standard TCM analysis using estimators based upon the normal distribution and ordinary least squares regression procedures.

A demand function was specified with the following form:

$$\ln(y_{i,j}) = \alpha_1 + \sum_{j=1}^{n} \beta_j p_{ij} + \gamma m_i + \delta x_i \qquad (9)$$

where some variables are as specified in equation (2) and the last, x_i, represents a vector of individual characteristics other than income and δ is a vector of parameters. Travel costs for the ith individual to the jth park, p_{ij}, were calculated using the following formula:

$$p_{ij} = \frac{\$0.22\ DIST_i}{GRP_i} + ENTF_j + [DAYF_j \times DAYS_i]$$

$$+ \frac{AIR}{GRP_i} + [\frac{1}{80} \times \frac{1}{4} \times (\frac{INC_i}{2040}) \times DIST_i] \qquad (10)$$

where $DIST_{ij}$ represents the round-trip distance between the ith's residence and the road entry point at park j, GRP_i represents the number of people in i's group on the trip, $ENTF_j$ is the park entry fee (if present), $DAYF_j$ is the daily park use fee (if present), $DAYS_i$ is the trip length in days, AIR is the cost of floatplane access from an air carrier's base to the backcountry drop point, and INC_i represents household income for i.

This formula identifies four components of travel cost: i) the out-of-pocket expenses for vehicle travel, estimated at \$0.22/km[3]; ii) the opportunity cost of travel time, estimated at one-quarter of the wage rate (Cesario 1976); iii) entry (Whiteshell Park) and daily use fees (Woodland Caribou Park); and iv) other costs such as payment for commercial floatplane access to backcountry areas (only in Atikaki and Woodland Caribou parks). The entry fees and daily user fees are reported in Table 1, and floatplane access usually cost a flat rate of \$477.80 plus \$25.00 per person (assuming 2 per canoe) from Bisset, Manitoba, where most floatplane services originated.

The distance from group leaders' home towns to each park were measured using a planimeter on 1:250 000 scale maps within Manitoba and northwestern Ontario, and highways maps for locations farther away from the parks within Canada, by the shortest highway route. Each

[3] Simulations were conducted with out-of-pocket costs. Each one-cent increase in cost resulted in a 1–2% change in resulting economic values. Ideally, costs should differ for respondents by province due to differing fuel costs and vehicle types. Incorporation of these features in calculations of travel costs is not justified given the level of knowledge about individuals and the aggregate nature of estimates of their socioeconomic characteristics (e.g., income).

park was assigned a common single entry point that was likely the most commonly used. Although some parks could be entered by two (Nopiming) or more (Whiteshell) locations, many of these are remote or are located far from major highways or population centers. The distances for U.S. visitors were measured using ZIPFIP[4] (Hellerstein et al. 1993) from their residences or zip codes to the border crossing that required the minimum total distance to be traveled to each park. For each individual group it was assumed that these out-of-pocket travel costs were split among members of the group.

The opportunity cost of travel time is a controversial feature of travel cost models (see Freeman 1993:448–452). In general, the economic literature has not reached a consensus on this issue. Cesario (1976) provides an extensive review of the urban commuting and transportation literatures and suggests that one-quarter to one-third of the wage rate is a reasonable compromise in applied research. Use of this fraction of the wage rate is typically applied in travel cost studies, and has been used in previous travel cost analyses of recreation in these parks (Boxall et al. 1996; Englin et al. 1996).

The actual calculation of the value of travel time used in this study is based on an average speed of 80 kmh, a fraction of the wage rate estimated by using a recreationist's estimated income (see below), and an assumption that each individual worked 2040 hours per year. A speed of 80 kmh was chosen because it represents a compromise among travel on paved highways, travel on unpaved roads of varying qualities, and stoppages for fuel, food, and supplies while traveling. In order to generate conservative travel cost estimates, travel time costs were estimated to be one-quarter the implied wage rate per hour (Cesario 1976). Note that in this calculation, each individual in a group had to pay his/her own travel time costs.

Other information obtained from the survey forms was used to estimate income, m_i, or other variables included in x_i. The availability of an individual's address and postal or zip code allowed the estimation of socioeconomic data using the most recent national censuses. For Canadian visitors, this was obtained from the 1991 Canada Census (Statistics Canada) 1993), and for U.S. visitors the information was obtained from ZIPFIP. Visitors from Europe were not included in the model due to difficulties in determining travel cost and socioeconomic variables. The socioeconomic data included average household income, average education level, and average household size. Socioeconomic information for the nearest population center to a registrant's address was used to obtain estimate in some cases. All estimates provided in U.S. dollars were converted to Canadian dollars based on the Bank of Canada official exchange rates for 1994 ($1.366 Can. = $1.00 USA). Thus, variables representing an individual's household income level, education, household size were available, and a dummy variable for having a U.S. residence was constructed (variable equaled 1 if the person lived in the U.S. and equaled zero if in Canada).

These variables were used in a maximum likelihood (ML) process where the value of the log likelihood function in equation (8) was maximized. This involved using programs written in GAUSS 3.2 software, where the Newton-Raphson and BHHH algorithms were used.

Results of the System of Demand Modeling Effort

Table 4 presents the ML results for the demand system. All four price coefficients are negative and significant well beyond the 5% level. The income parameter is positive, but not statistically significant. This insignificance could reflect the imprecision with which this variable was measured. Atikaki and Woodland Caribou parks receive significantly more visitors from the U.S. than can be explained by the price and income coefficients alone. This conforms with the descriptive data that identifies these two parks as more frequent destinations for U.S. recreationists. On the other hand, Nopiming and Whiteshell receive fewer U.S. visitors than can be explained by the price and income parameters.

[4] ZIPFIP is a non-commercial computer program that includes i) a database of distance between any two zip code locations or FIP (regional) location, and ii) U.S. census information by zip code.

Table 4. Maximum likelihood estimates of recreation demand parameters for a system of four Canadian wilderness parks

Variable	Parameter (Standard Error)
Intercept	-0.27742[a] (0.13368)
Nopiming travel cost	-0.00132[a] (0.00045)
Atikaki travel cost	-0.00009[a] (0.00003)
Whiteshell travel cost	-0.00051[a] (0.00017)
Woodland travel cost	-0.00011[a] (0.00004)
Nopiming U.S. dummy[b]	-1.40115[a] (0.25452)
Atikaki U.S. dummy[b]	1.79355[a] (0.22187)
Whiteshell U.S. dummy[b]	-1.75135[a] (0.41546)
Woodland U.S. dummy[b]	2.67034[a] (0.16901)
Income ('000 $)	0.00167 (0.00295)
Log Likelihood	-2108.69

[a] Parameter is significant at the 5% level or beyond.
[b] These shift parameters are dummy variables where the value is 1 if the individual resided in the U.S., and 0 if in Canada.

Calculating the full compensated demand system implied by those parameters provides more details on these findings (Table 5). Here,10 of the 28 parameters are repeated from Table 4. These include the own-price parameters, the intercept on Nopiming Park, the income parameter, and the U.S. shift parameters; however, the intercept terms for Atikaki, Whiteshell, and Woodland Caribou provincial parks were calculated using equation (4). The cross-price effects were estimated using equation (5), where the quantities of trips were the actual quantities observed. The cross-price effects were calculated for each individual (i.e., equation (5) was calculated for every individual in the sample) and the parameter was estimated by taking the mean of these individual cross-price effects.

Two issues need to be addressed with these calculations of cross-price effects. First, is the fact that the cross-price effects were estimated despite the income parameter not being significantly different than zero. This was due to the possible imprecision with which income was measured. Second, the use of actual quantities over estimated quantities is an empirical issue. Bockstael and Strand (1987) describe this concern

Table 5. Implied compensated demand parameters for backcountry recreation trips to four Canadian wilderness parks

Variable	Nopiming	Atikaki	Whiteshell	Woodland Caribou
Intercept	-0.27742	-0.01860	-0.10685	-0.02226
Price coefficients				
Nopiming	-0.00132	0.03026	0.02670	0.01778
Atikaki	0.03026	-0.00009	0.00000	0.00711
Whiteshell	0.02670	0.00000	-0.00051	0.00000
Woodland Caribou	0.01780	0.00711	0.00000	-0.00011
Demand shifters				
Income ('000 $)	0.00167	0.00167	0.00167	0.00167
USA visitor dummy	-1.40115	1.79355	-1.75135	2.67034

in benefit measurement as comparing the errors that arise from recreationists recalling their trips and errors that arise from the regression model. The use of the actual quantities can be justified because the data used in this study are not based on a recall questionnaire. Furthermore, the resulting compensated demands using the actual trips are consistent with *a priori* expectations as discussed below.

The compensated demand system (Table 5) resembles a linear demand system with cross-price symmetry imposed on the estimates. In this case, however, the specific cross-price parameters are dependent on the quantities at which the system was evaluated. Because the cross-price terms are all calculated as $0.00167 \leftrightarrow y_k y_j$ the positive sign on the income effect suggests that most parks are substitutes for each other, partially confirming the hypotheses presented in the first section of this report. If visits to one park are negatively affected by management, economic, or environmental conditions, individuals will switch their trips to one of the other parks in the system. It is interesting to note, however, that Atikaki and Woodland Caribou parks are not substitutes for Whiteshell trips, and Whiteshell is not a substitute for wilderness trips to Woodland Caribou. This makes sense given that Atikaki and Woodland Caribou parks are more remote and less developed than Whiteshell.

Consumer surplus was estimated by taking the inverse of the own-price parameter ($1/\beta_{jj}$) for each park. Bockstael and Strand (1987) and Adamowicz et al. (1989) derive this measure for use in semilogarithmic demands. The data used to estimate the demand model were trips per group, thus $1/\beta_{jj}$ represents the consumer surplus per trip, per group. Table 6 provides surplus estimates for the groups and summary statistics that decompose them into individual and daily welfare estimates.

The consumer surplus associated with trips to Atikaki and Woodland Caribou is the highest of the four parks. In addition, the surplus estimates are higher for Whiteshell than Nopiming. While the former finding is not surprising, the latter is. The economic benefits of backcountry trips to Nopiming were expected to be higher than those for Whiteshell due to lower levels of development and the fact that there was no entry fee. The magnitudes of the welfare measures for Atikaki and Woodland Caribou parks are not surprising. These figures seem large, but it must be emphasized that they are associated with trips of long duration in comparison to the lengths of trips to the other two parks. The average trip length to Whiteshell and Nopiming is about 2.5 days, or just over a weekend. This is consistent with the fact that these parks are more accessible by road than

Table 6. Estimates of use, group size, travel costs, and consumer surplus for recreation trips to four wilderness parks in a backcountry recreation demand system in the Canadian Shield

Variable	Nopiming	Atikaki	Whiteshell	Woodland Caribou
Mean days/trip	2.72	6.45	2.50	6.00
Mean group size/trip	4.03	5.93	4.41	3.81
Mean travel cost ($) per person per trip	102.57	389.30	102.14	203.15
Consumer surplus per group per trip ($)	758.54	11 312.60	1 969.46	9 451.47
Consumer surplus per person per trip ($)	188.22	1 907.69	446.59	2 480.70
Consumer surplus per person per day ($)	69.20	295.77	178.64	413.45
Estimated total use (group trips in 1993 and 1994)[a]	661	94	334	201
Aggregate value ($) of the benefits per park for 1993 and 1994[b]	501 395	1 063 384	657 813	1 899 745

[a] Estimates come from Table 1. Note that the Whiteshell estimate is low because an intensive data-collection effort was only implemented for 1994.

[b] These were derived by multiplying the consumer surplus per group by the estimated total use.

Atikaki or Woodland Caribou, and are closer to a major population centre (Winnipeg).

As expected, presenting the values in individual and daily forms results in a reduction of the size of the surplus measures. The per-person trip estimates were generated by dividing the group-trip estimate by the average number of people in groups for each park. The average values for Nopiming are comparable to recreation values reported in the literature. The values for the other three parks while higher, are probably not significantly different from the price of a week-long fishing trip at a backcountry lodge or a week-long holiday at a tropical destination.

In decomposing these trip estimates into daily estimates (Table 6), it was found that a day of backcountry recreation provided benefits worth about $70 at Nopiming and over $400 at Woodland Caribou. Once again, the large estimates at the two remote parks were probably not much different than trips provided by commercial outfitters to remote destinations in other parts of the world. Given that many visitors to Atikaki and Woodland Caribou parks were from distant areas of the U.S., these results are not surprising.

Table 6 also provides an estimate of the aggregate benefits provided by each park over the 2-year period. As expected, Atikaki and Woodland Caribou provided considerable large wilderness recreation benefits. The benefits provided by Whiteshell were larger than those provided by Nopiming; however, these aggregate benefit estimates were smaller than those provided by Rollins et al. (1997) for similar recreational activities in three other Ontario wilderness parks for 1993. Rollins et al. (1997) concluded that Algonquin Park provided benefits of $9,218,730, Quetico generated $8,041,444, and Killarney provided benefits of $2,373,212.

In order to calculate the total value of benefits provided by these parks, however, the wilderness recreation aggregate benefit estimates must be added to the economic values of any other

services provided by these parks. These services include camping at managed campgrounds, recreational hunting and fishing, commercial lodges and outpost camps, wild rice harvesting, and similar activities. Furthermore, the economic benefits (both market and nonmarket) derived from preservation of the various ecosystems and wildlife associated with the parks must also be considered. The values of these other benefits are largely unknown at this time.

A number of features of the model suggest caution in interpreting these values. First, two data issues must be described. These are: the use of aggregate level information for individual socioeconomic characteristics such as income, education and household size; and the lack of data for Quetico and the BWCA. The aggregate data issue is serious in that confidence cannot be placed in the statistical insignificance of the income effect generated by the econometric model (Table 4). The fact that two important parks were omitted from the analysis is significant in that these parks might be important substitute sites in the system of demands, particularly for U.S. residents.

A second issue involves the form of the econometric model used to estimate the demands and values. This model does not account for the possibility of a truncated sample. This means that the model does not account for the probability of an individual who visited one park but did not visit any of the other three parks. Many researchers have examined these effects (e.g., Creel and Loomis 1990; Grogger and Carson 1991;Yen and Adamowicz 1993) and found that the consumer surplus measures are sensitive to such effects. In fact, Yen and Adamowicz (1993) found that using untruncated estimators (such as the ones used in this study) on a truncated sample can provide misleading results. On the other hand, they found that truncated estimators used on truncated data led to large and highly variant welfare measures. The bottom line is that the confidence of the results of the present study would be improved with individual visitation information from both the two missing parks, and from a random sample of people taken from the most-likely market areas for the demand system.

While not necessarily accurate in magnitude, however, welfare measures can be accurate in terms of their relative comparison. Comparing the values among the parks suggests that the typical trip to the two remote parks, Atikaki and Woodland Caribou, might be quite different from those to Nopiming or Whiteshell. While this is not surprising, what is curious is that these differences in the values of the recreational experiences are not recognized in the management of these parks. For example, there is no fee at Atikaki, and the Woodland Caribou fee is the same as that charged at any other provincial park in Ontario (Table 1). Knowledge of the consumer surplus estimates (Table 6), and of the distribution of these benefits among international visitors (Fig. 5), should provide reasons for managers to construct differential fee schedules that can assist in generating revenue for improved management and access. For example, while park management is funded largely through provincial tax revenues, these parks provide considerable economic benefits to U.S. visitors that are not reflected in the entry or daily use fees they are charged.

CONCLUSIONS AND STUDY LIMITATIONS

The major questions addressed in this report involve issues of the rate of cross-visitation across the four parks studied, the effect of the recent addition of Woodland Caribou Park to this system, and the values associated with wilderness recreation in these parks. The results of the model application used for this study suggest that Nopiming, Atikaki and Woodland Caribou parks are substitutes for each other. Whiteshell is only considered a substitute park for Nopiming visitors. In addition, the observation that U.S. residents are more likely to visit Atikaki and Woodland Caribou parks than Nopiming or Whiteshell was supported by the statistical results of the model. The degree of cross-visitation among these latter three parks was likely influenced by the addition of Woodland Caribou to the wilderness park system in the area.

In terms of nonmarket economic benefits, the results suggest that these four parks provide considerable economic benefits—the value of a day of backcountry recreation in these parks appears to be substantial. The most remote of the parks, Woodland Caribou, is estimated to provide daily benefits of over $400 per day per person.

Several key limitations to the study seem clear. One is that the analysis is unable to use any individual-specific demographic information. Individual information would help to show the role that individual characteristics play in the analysis. A second limitation is that key parks that should be in the system are missing in the formal demand analysis. These parks are the BWCA and Quetico Provincial Park. Finally, the form of the econometric model should be improved to consider the effect of interpark truncation effects. This improvement would require the model to consider explicitly the fact that some individuals never visited a park in the system during the period that visitation data were collected.

While limited, however, the construction of the demand system model and the generation of economic benefits was only possible through the gathering of appropriate registration data. This data could be easily collected and linked through digital methods to census and other data bases. It is recommended, therefore, that managers of public lands examine opportunities to construct or change current registration systems to collect information from the recreational users. This improved information base can be used to construct similar models for other areas, and to improve the flow of information into policy and management decision making.

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